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GERMINATION OF SOME PINES, AND OTHER TREES ¹

L. H. PAMMEL AND C. M. KING

INTRODUCTION

In 1917 the authors began a study of the germination of trees and shrubs native to Iowa, for the purpose of extending our knowledge of the life history of some of our common woody plants.

In scanning the literature we found that writings upon the early and juvenile forms of shrubby plants native to Iowa very scant. In succeeding papers we extended the study to include species of other sections of the country as well as a few exotic genera.

It is true that many of those native to Europe and commonly cultivated there were described by Sir John Lubbock in his exhaustive treatise "Seeds and Seedlings," and Sargent in "North American Silva" described many of the seedlings; but only a small part of those commonly met with were described. Our studies were therefore continued to extend this knowledge. The literature of the subject was fully given in previous papers.

It is interesting to note that the juvenile forms of closely related species and genera always show some common characters in color and shape of cotyledons. Thus the color of the young forms of the various species of dogwood (*Cornus*) and related genera have some points of resemblance. The same is true of *Betula* and *Quercus*.

This contribution contains chiefly a study of some of the conifers of the genera *Pinus*, *Larix*, *Picea* and *Sequoia*.

PINACEAE

Pinus Strobus L. White Pine. Seeds obtained from Prof. G. B. MacDonald, planted in the greenhouse March 10, 1925, germinated from March 20-26.

Germination epigeaeous. Hypocotyl reddish purple; cotyledons 10, fifteen-sixteenths of an inch in length, slender, green decidedly glaucous.

¹ A Series of papers upon Germination of Trees and Shrubs of which this is the eighth has appeared in the Proceedings of Iowa Academy of Science beginning with the year 1917.

Resembles seedling of *P. Banksiana* but brighter green.

Pinus Banksiana Lamb. Gray or Northern Scrub Pine, Jack Pine. Seeds obtained from Prof. MacDonald, planted March 10, 1925, germinated very freely March 18-20.

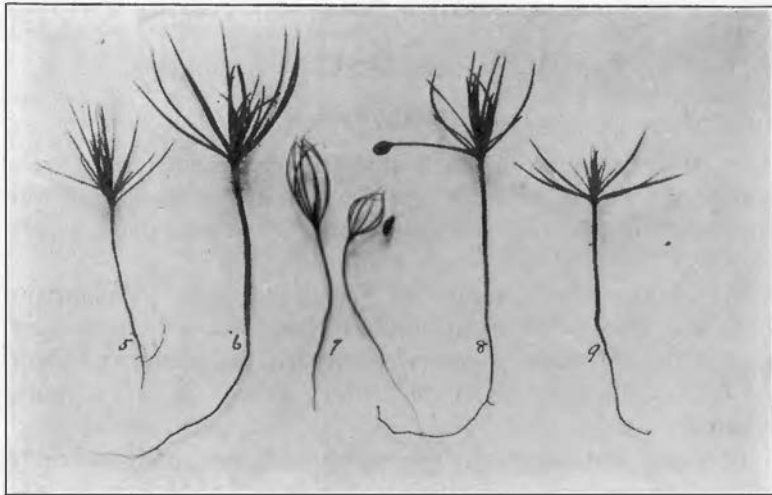


Fig. 1. Seedlings of Conifers. 5, Austrian Pine (*Pinus austriaca*). 6, White Pine (*P. strobus*). 7, Norway Pine (*P. resinosa*). 8, Scotch Pine (*P. sylvestris*). 9, Jack Pine (*P. banksiana*) (Photographed by Photo Sect. Ia. Exp. Sta.)

Germination epigeaeus. Hypocotyl reddish purple in color; cotyledons 4, slender, about fifteen-sixteenths of an inch long, slightly glaucous.

Bud small, green.



Fig. 2. Seedlings of *Pinus austriaca*, hearing seed at top of needles, illustrating manner of emerging from seed common to conifers. Drawn by C. M. King

Pinus austriaca Höss Austrian Pine. The seeds of this pine, obtained from Prof. MacDonald, were planted in the greenhouse March 10, 1925; 90% of them germinated March 17-18. Out of doors the seeds of this pine were being scattered upon the campus, February 20-25.

Germination epigaeous. Hypocotyl thick, reddish. Cotyledons 6, slender, green, needle-pointed. The seed coat containing the remainder of the endosperm, is borne upon the tips of the cotyledons as they rise from the soil. When the cotyledons are full grown, the seed coat drops off and the needles spread out.

First cluster of true leaves, with 5 needles, green, smooth, $1\frac{1}{8}$ inches long.

Pinus sylvestris L. Scotch Pine. Seeds obtained from Prof. MacDonald were planted March 10, 1925 and were germinating freely from March 17-24.

Germination epigaeous. Hypocotyl purple below, green above. Cotyledons 7, $\frac{3}{8}$ inch in length. Bud small.

Pinus resinosa Laws. Seeds furnished by Prof. MacDonald,



Fig. 3. *Pinus pinea*. Seedling. Photo by Photo Section, Iowa Agr. Exp. Sta.

planted in the greenhouse March 10, 1925 germinated freely March 17-20.

Germination epigaeous. Hypocotyl reddish. Cotyledons 6-8, fleshy, glaucous, green.

As in all other seedlings of pines, the seed was lifted out of the soil, upon the tips of the cotyledons, and remaining there until all endosperm was absorbed.

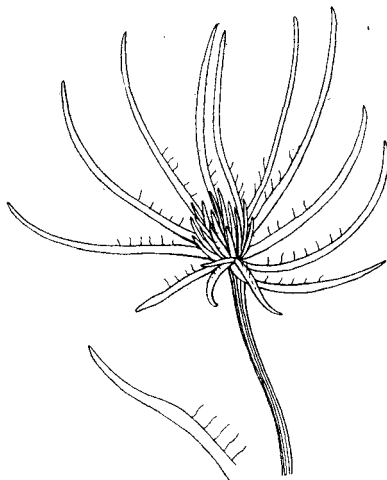


Fig. 4. *Pinus pinea*. Seedling, and leaf margin showing hairs. Drawn by C. M. King

Pinus pinea L. Seeds from the Mediterranean region. Germination in two weeks time, 90%. Planted February 11, 1925, germinated February 25.

Germination epigaeous. Seed coat hard and woody. The cotyledons back out of the endosperm, which with the seed coat is brought up on their tips. The cotyledons appear, with tips still in soil, at length lifting the seed coat out, and up to vertical position. When the endosperm has been absorbed, the cotyledons free themselves from the seed coat, and stretch out toward a horizontal position. Cotyledons 12 to 14 in number, 2 inches in length. The hypocotyl green, thick, fleshy, each bearing upon the upper or inner a row of delicate colorless hairs.

Color, glaucous green. The bud of first leaves, conical.

Larix laricina (DuRoi) Koch. American Larch. Seeds brought in from campus, planted in the greenhouse March 10, 1925, germinated about 80%, March 17.

Germination epigaeous. Hypocotyl green. Cotyledons 5, one-half inch in length, green. First bud conical. The seedling resembles that of *L. decidua*.

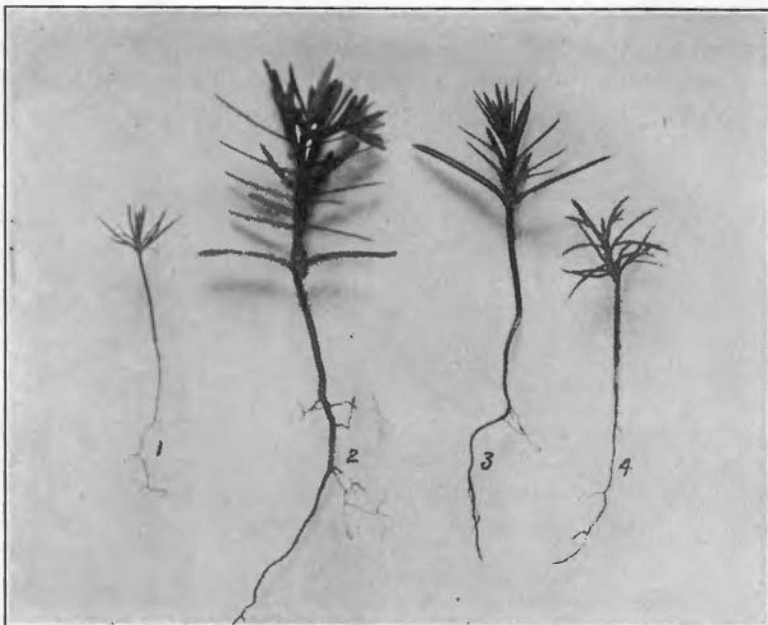


Fig. 5. Seedling of Conifers, I. 1, White Spruce (*Picea canadensis*). 2, Redwood (*Sequoia sempervirens*). 3, Chinese Arbor-vitae (*Thuja orientalis*). 4, European Larch (*Larix decidua*) (Photographed by Photo Sect. Ia. Exp. Sta.

Larix decidua Mill. European Larch. Seeds from campus trees, planted in the greenhouse March 10, 1925, germinated freely March 17.

Germination epigaeous. Hypocotyl fleshy, green. Cotyledons 5, $\frac{5}{8}$ of an inch long, green.

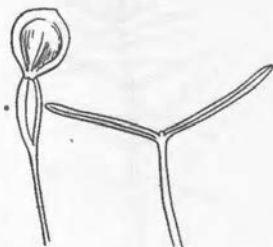


Fig. 6. *Sequoia sempervirens* (a). 1st and 2nd stages. Drawn by C. M. King

Picea canadensis (Mill) B S P. White Spruce. Seeds planted in the greenhouse March 10, 1925, germinated March 21-24.

Germination epigaeous. Hypocotyl green. Cotyledons 6, one-half inch long, fleshy. Bud small.

Picea Abies (L.) Karst. Norway Spruce. Seeds planted in the greenhouse March 10, 1925; germination fair March 20-24.

Germination epigaeous. Hypocotyl purplish, slightly glaucous. Cotyledons 4 to 7, $\frac{2}{3}$ inch in length, green. Bud small.

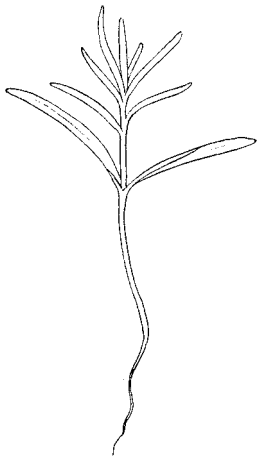


Fig. 7. *Sequoia sempervirens* (b). Seedling. Drawn by C. M. King

Sequoia sempervirens Endl. Redwood. Seeds obtained from Berkeley, California in February, 1925. Planted in greenhouse March 10, germinated about 90%, March 19-21.

Germination epigaeous. In germination, the seed coat is brought to the surface on the tips of the cotyledons, and is pushed off as they elongate, and spread apart. The radicle is brownish, slender.

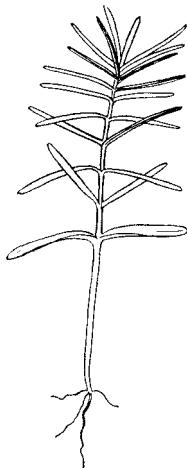


Fig. 8. *Sequoia sempervirens* (c). Seedling. Drawn by C. M. King

Lower part of caulicle is pale in color, the part just below the cotyledons soon becoming greenish. Caulicle is fleshy. Cotyledons 2, wide-linear, about $\frac{3}{4}$ inch in length, fleshy, smooth, dark green, midrib obscure. The 1st and succeeding leaves slightly

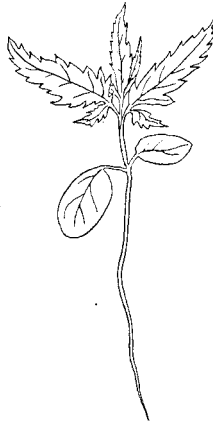


Fig. 9. *Schinus molle* (b). Seedling. Drawn by C. M. King

narrower than cotyledons. Above the 9th pair of leaves the stem divides into 2 branches.

Thuja orientalis L Chinese Arbor-vitae. Seeds, obtained from Prof. MacDonald, planted in greenhouse March 10, 1925, germinated poorly March 22.

Germination epigaeous. Hypocotyl reddish. Cotyledons 2, linear, smooth, five-twelfths inch in length, flat. Midrib prominent. Color above and below yellowish green.

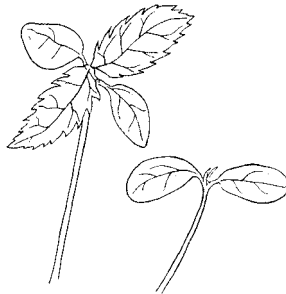


Fig. 10. *Schinus molle* (a). 2 stages of seedling. Drawn by C. M. King

ANACARDIACEAE

Schinus molle L. Pepper-tree. Seeds received from California



Fig. 11. *Schinus molle*. Seedling. Photo by Photo Section, Iowa Agr. Exp. Sta.

at Christmas time 1924. Planted in the greenhouse Jan. 15, 1925. Seedlings appeared Feb. 10. Germination 95%.

Germination epigeaeous. Stem reddish. Radicle pale in color. Cotyledons 2, ovate, fleshy, prominently veined, slightly pubescent on the midrib. The lower surface slightly paler than the upper surface. The veins terminate at the margin in the teeth. The

lower serrations are deeply cut. Stem between the cotyledons and first pair of leaves smooth, reddish. The seedling has the

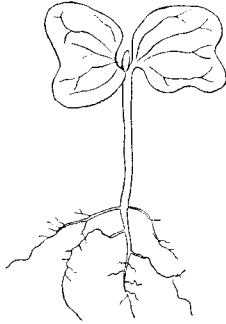


Fig. 12. *Rhamnus Frangula*. Seedling, 1st stage. Drawn by C. M. King

general aspect of *Rhus*. Third leaf prominently veined, coarsely dentate, with one basal leaflet. Fourth leaf compound, a pair of basal leaflets.

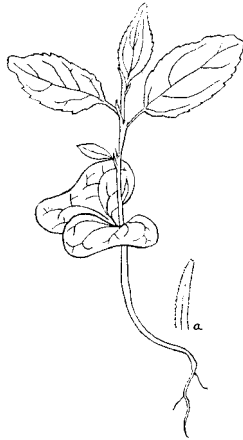


Fig. 13. *Rhamnus Frangula*, seedling. a, stipule. Drawn by C. M. King

RHAMNACEAE

Rhamnus Frangula L. Seeds planted in greenhouse about March 1, 1925; germinated March 20.

Germination epigeaeus. Cotyledons large, obcordate, venation reticulate, obscure. Hypocotyl green. First leaf a green stipule-like scale; 2nd lanceolate, one-third inch in length, acuminate, margin with minute hairs. Third leaf oval, serrate prominently veined, slightly notched at tip. Minute stiff hairs on stem, petioles,

margins of leaves and ribs of under side of leaves. Fourth and 5th leaves like the 3rd. All leaves with stipules, leafy, slender, pointed.

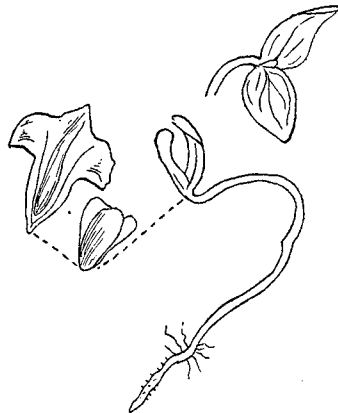


Fig. 14. *Betula alba* var *papyrifera*. Nutlets, and emerging seedlings.
Drawn by C. M. King

BETULACEAE

Betula alba var *papyrifera* (Marsh) Spach. Paper Birch.
(See description Proc. Ia. Acad. Sci 31.)

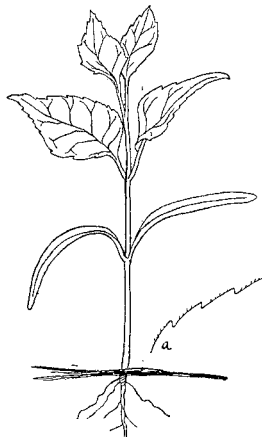


Fig. 15. *Fraxinus pennsylvanica* var *lanceolata*. a, marginal serrations.
Drawn by C. M. King

OLEACEAE

Fraxinus pennsylvanica var *lanceolata* (Borkh.) Sarg. Green Ash.

(For description see Proc. Ia. Acad. Sci., 25, p. 337)